

K Mesons

Cheng-Ju S. Lin

Lawrence Berkeley National Laboratory

Overseer: Cheng-Ju Lin (LBNL, experimentalist)

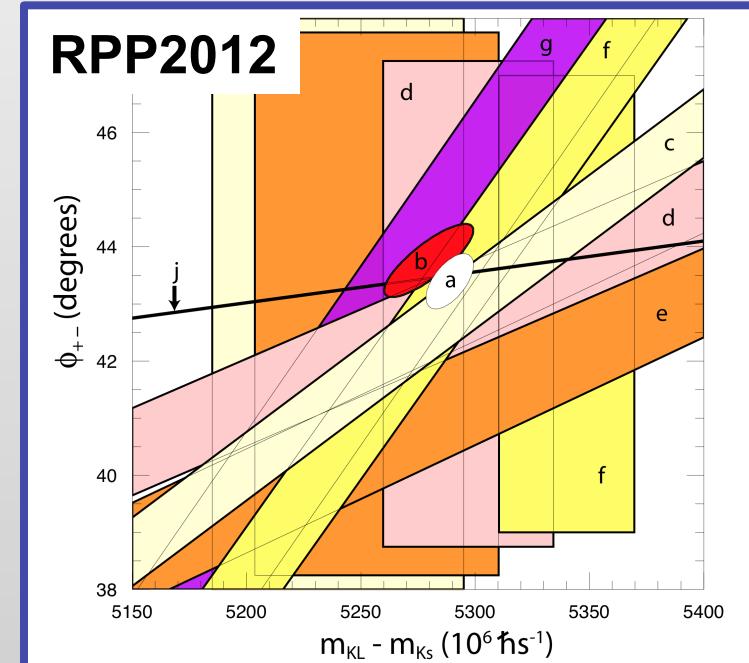
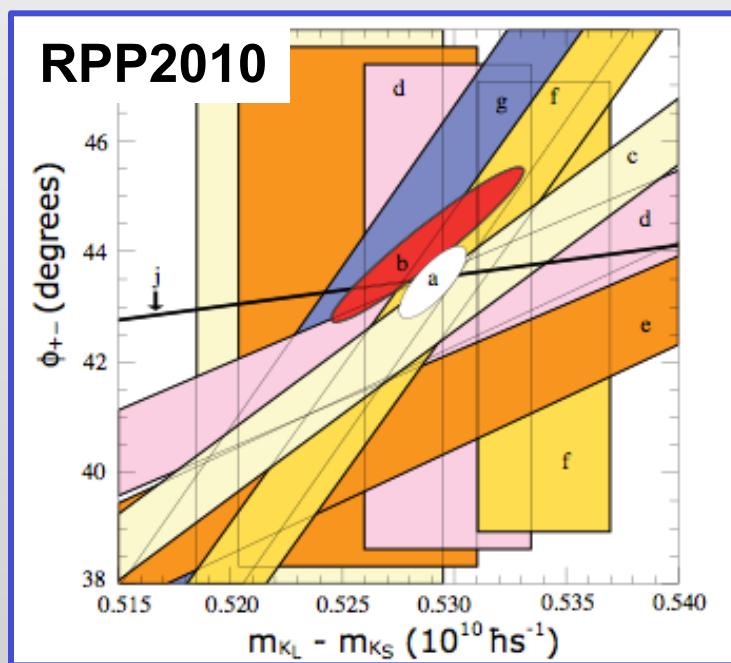
Analyst/Encoder: Giancarlo D'Ambrosio (INFN, theorist)

RPP 2012 Edition:

- 21 publications
- 54 measurements

**Precision measurements of K-meson properties,
Including CP violation parameters and tests of CPT
invariance**

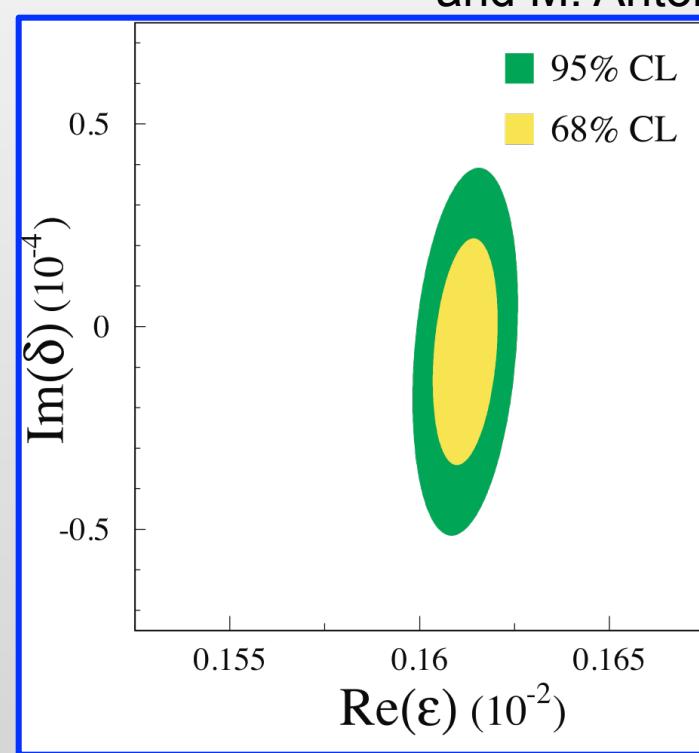
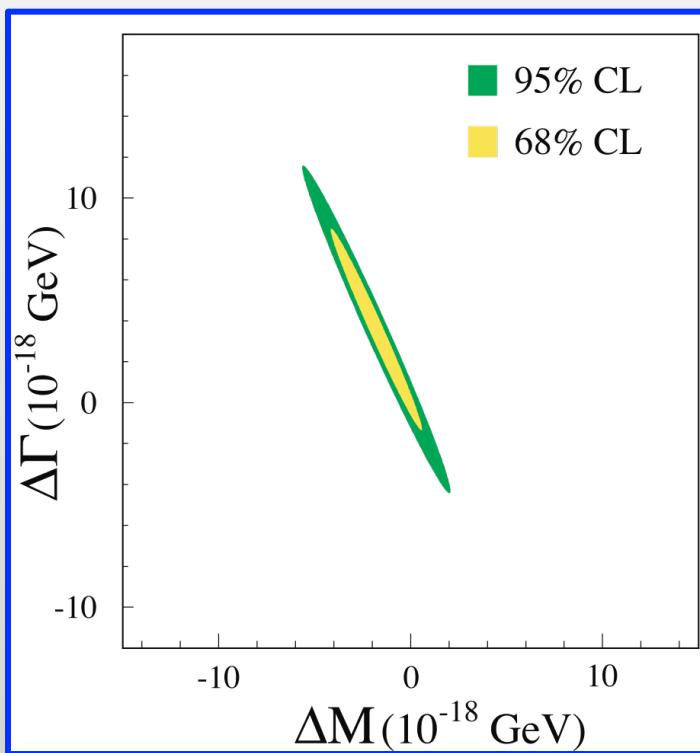
- KTeV updated CP violation and CPT symmetry results in K_L system using the full dataset
- Improved measurements of K_L - K_S mass difference and K_S lifetime [PDG2012 $\tau(K_S) = 0.8954 \pm 0.0004 \text{ } 10^{-10} \text{ s}$]



C.-J. Lin –October 2012

- Stringent constraints on K^0 and \bar{K}^0 mass difference
- Direct CP violation parameters

(from G. D'Ambrosio
and M. Antonelli)



PDG 2012:

$-4.0 \times 10^{-19} \text{ GeV} < m_{K^0} - m_{\bar{K}^0} < 4.0 \times 10^{-19} \text{ GeV}$ (95% C.L.)

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- New NA48 result on $K^+ \rightarrow \pi^+ \pi^0 \gamma$
- Interesting probe of CP violating effects

RPP2010

Hadronic modes with photons or $\ell\bar{\ell}$ pairs			
Γ_{21}	$K^+ \rightarrow \pi^+ \pi^0 \gamma$	[a,b]	$(2.75 \pm 0.15) \times 10^{-4}$
Γ_{22}	$K^+ \rightarrow \pi^+ \pi^0 \gamma$ (DE)	[a,e]	$(4.3 \pm 0.7) \times 10^{-6}$

RPP2012

Hadronic modes with photons or $\ell\bar{\ell}$ pairs			
Γ_{21}	$\pi^+ \pi^0 \gamma$ (INT)	(- 4.2 ± 0.9)	$\times 10^{-6}$
Γ_{22}	$\pi^+ \pi^0 \gamma$ (DE)	[a,e] (6.0 ± 0.4)	$\times 10^{-6}$

- Modified encoding scheme for this edition

$$\Gamma(\pi^+ \pi^0 \gamma(\text{INT})) / \Gamma_{\text{total}}$$

$$\Gamma_{21} / \Gamma$$

The $K^+ \rightarrow \pi^+ \pi^0 \gamma$ differential decay rate can be described in terms of T_{π^+} , the charged pion kinetic energy, and $W^2 = (P_K \cdot P_\gamma)(P_{\pi^+} \cdot P_\gamma) / (m_K m_{\pi^+})^2$; then we can write $d^2\Gamma(K^+ \rightarrow \pi^+ \pi^0 \gamma) / (dT_{\pi^+} dW^2) = d^2\Gamma(K^+ \rightarrow \pi^+ \pi^0 \gamma)_{IB} / (dT_{\pi^+} dW^2) [1 + 2 \cos(\pm\phi + \delta_1^1 - \delta_0^2) m_\pi^2 m_K^2 W^2 X_E + m_\pi^4 m_K^4 (X_E^2 + X_M^2) W^4]$. The IB differential and total branching ratios are expressed in terms of the non-radiative experimental width $\Gamma(K^+ \rightarrow \pi^+ \pi^0)$ by Low's theorem. Using PDG 10 $B(K^+ \rightarrow \pi^+ \pi^0) = 0.2066 \pm 0.0008$, one obtains respectively $B(K^+ \rightarrow \pi^+ \pi^0 \gamma)_{IB}$ ($55 < T_{\pi^+} < 90$ MeV) = 2.55×10^{-4} and $B(K^+ \rightarrow \pi^+ \pi^0 \gamma)_{IB}$ ($0 < T_{\pi^+} < 80$ MeV) = 1.80×10^{-4} . Fitting respectively the piece proportional to W^2 and the piece proportional to W^4 , the interference contribution (INT), proportional to X_E , and the direct contribution (DE) proportional to $X_E^2 + X_M^2$ are extracted.

-October 2012

We have 8 mini-reviews in the K-meson listings

10 Review authors:

M. Antonelli (INFN), G. D'Ambrosio (INFN), E. Blucher (Chicago),
C.-J. Lin (LBNL), L. Littenberg (BNL), W.J. Marciano (BNL),
T. Nakada (PSI), T.G. Trippe (LBNL), G. Valencia (Iowa),
L. Wolfenstein (Carnegie-Mellon)

**Most reviews included only minor updates for
RPP 2012**

Updated Reviews:

- **Rare Kaon Decays**
- **CPT Invariance Tests in Neutral Kaon Decay**
 $-4.0 \times 10^{-19} \text{ GeV} < m_{K^0} - m_{\bar{K}^0} < 4.0 \times 10^{-19} \text{ GeV}$ (95% C.L.)
- **V_{ud} , V_{us} , The Cabibbo Angle, and CKM Unitarity**
 $|V_{us}| = 0.2252 \pm 0.0009$ (RPP2012, same RPP2010)
- **CP Violations in K_L Decays**

- Steady flow of K-meson results from KLOE, NA48, KTeV, and others
- $|V_{us}|$ error reduced significantly using Lattice calculation of $f_+(0)$
- No major issues in K-meson listing for RPP 2012
- New rare K-meson experiments coming online in near future (e.g $K \rightarrow \pi\nu\bar{\nu}$)